

SUPPORT FOR THE AMENDMENT

Support for the amendment to claim 1 is found in claims 7 and 8 as originally presented. No new matter would be added to this application by entry of this amendment.

Upon entry of this amendment, claims 1-6 and 9-12 will now be active in this application.

### REQUEST FOR RECONSIDERATION

The claimed invention is directed to a process reacting thermoplastic polyurethanes with compounds having isocyanate groups which comprises aliphatic isocyanates having at least three isocyanate groups and aromatic diisocyanates, in a ratio of 1:1 to 1:10.

Thermoplastic polyurethanes (TPUs) are well known polymers whose property profile has been recognized as improvable by introducing crosslinking. Issues as to premature crosslinking, which can impede extrusion, as well as a desire for maximum crosslinking must be considered. Simple techniques for introducing a high degree of crosslinking are sought.

The claimed invention addresses this problem by providing a process in which a TPU is reacted with an isocyanate composition comprising iia) aliphatic isocyanates having at least three isocyanate groups and iib) aromatic isocyanates having two isocyanate groups in a ratio of 1:1 to 1:10. Applicants have discovered a mixture of **aliphatic** isocyanates having **at least three** isocyanate groups and **aromatic isocyanates** having two isocyanate groups, in a ratio of 1:1 to 1:10 to provide for good crosslinking properties which can be achieved simply such as by reacting in an extruder or injection molding apparatus. Such a process is nowhere disclosed or suggested in the cited references of record.

The rejections of claims 1, 2, 4, 7-9 and 12 under 35 U.S.C. §103(a) over Lagneaux et al. (PCT FR02/03646) is respectfully traversed.

The cited reference fails to suggest reacting a TPU with an isocyanate containing composition comprising aliphatic at least triisocyanate and aromatic diisocyanate at a ratio of from 1:1 to 1:10 nor the enhanced processability with a high degree of crosslinking obtained thereby. Applicants note that the claims have been amended to recite an aliphatic at least triisocyanate and aromatic diisocyanate ratio of from 1:1 to 1:10.

As evidence of the enhanced properties obtained by reacting aliphatic at least triisocyanate and aromatic diisocyanate in a ratio of from 1:1 to 1:10, the examiner's

attention is directed to example 4, Table 2 of applicants' specification. The table reports solubility for samples prepared with a 1:2 ratio of aliphatic at least triisocyanate and aromatic diisocyanate (isocyanate mixture (b)), a 1:4 ratio (isocyanate mixture (a)) and only diisocyanate (isocyanate (c)) For the examiner's convenience the data from Table 2 is reproduced below:

TABLE 2

Soluble fractions of the materials obtained in Example 3.				
Isocyanate added	Addition of isocyanate in percent by weight, based on extruder output	Heat-conditioning	Addition to DMF	Soluble fractions (%)
—	0	20 h at 100° C.	Dibutylamine 1%	100
(b)	2.5	20 h at 100° C.	Dibutylamine 1%	8
(a)	2.5	20 h at 100° C.	Dibutylamine 1%	54
(b)	4	20 h at 100° C.	Dibutylamine 1%	1
(a)	4	20 h at 100° C.	Dibutylamine 1%	33
(c)	4	20 h at 100° C.	Dibutylamine 1%	100
—	0	20 h at 100° C.		100
(b)	2.5	20 h at 100° C.		2
(a)	2.5	20 h at 100° C.		2
(b)	4	20 h at 100° C.		2
(a)	4	20 h at 100° C.		2
(c)	4	20 h at 100° C.		40
—	0		Dibutylamine 1%	100
(b)	2.5		Dibutylamine 1%	88
(a)	2.5		Dibutylamine 1%	100
(b)	4		Dibutylamine 1%	15
(a)	4		Dibutylamine 1%	82
(c)	4		Dibutylamine 1%	100
—	0			100
(b)	2.5			15
(a)	2.5			7
(b)	4			3
(a)	4			3
(c)	4			45

The data makes clear, for all comparisons in which the wt.% of isocyanate and heating-conditions were comparable, the compositions resulting from reaction of an aliphatic

at least triisocyanate and aromatic diisocyanate is a ratio of at least 1:1 to 1:10, (isocyanates (b) and (a)) that reduced solubility (e.g. greater crosslinking) was observed relative to a sample in which only diisocyanate was added (isocyanate (c)). Such low degree of solubility was obtained even though the samples were prepared from an extruder, conditions where it has heretofore been difficult to get a high degree of crosslinking. Thus, the claimed process in which a mixture of an aliphatic at least triisocyanate and aromatic diisocyanate at a ratio of at least 1:1 to 1:10 has been demonstrated to provide an enhanced process since a highly crosslinked product is possible. Example 5 demonstrates processing of a thermoplastic polyurethane which is even harder than that used in example 1. Thus, a scope of processability has been demonstrated.

As proposed by the examiner, applicants refer to the text of U.S. 2004/0236035 in reference to Lagneaux et al..

Lagneaux et al. fail to disclose or suggest polyurethane reaction with the combination of aliphatic at least triisocyanate and aromatic diisocyanate at a ratio of 1:1 to 1:10.

Lagneaux et al. describes the use of thermoplastic polyurethanes either alone or blended with other polymers, which are grafted with a crosslinking agent of diisocyanate **trimers** or blocked isocyanates. Paragraph [0018] identifies only reaction of **trimers** of diisocyanates such as IPDI, an aliphatic diisocyanate **trimer**, as well as TDI, an aromatic diisocyanate trimer. Paragraph [0019] allows for use of blocked isocyanate dimers or trimers, but prefers a trimer of IPDI (paragraph [0021]). There is no suggestion of a ratio of aliphatic at least trimer to aromatic dimer of 1:1 to 1:10.

Page 2 of the outstanding official action appears to recognize this deficiency "While the invention does not generically include the use of mixtures of the acceptable isocyanates,..." but the office action points to example 3, asserting a disclosure of a mixture

of MDI an aromatic diisocyanate and IPDI trimer an aliphatic isocyanate having three isocyanate groups.

Applicants note that example 3 identifies **three different compositions** 1) a mixture of 58277 (70 wt. %) and Tufprene:A (30 wt. %), 2) a mixture of 58277 (70 wt. %), Tufprene:A (30 wt. %) and IPDI: trimer (3 p.h.r.) and 3) a mixture of 58277 (70 wt. %), Tufprene:A (30 wt. %) and MDI (3 p.h.r.). Thus, by describing the use of IPDI trimer and MDI in **separate** compositions, there is no disclosure or suggestion of the isocyanate component being comprised of aliphatic isocyanates having at least three isocyanate groups and aromatic diisocyanates **in the same composition** much less in a ratio of 1:1 to 1:10. To the contrary, a mixture is not even suggested.

In contrast, the claimed invention is directed to a process in which a TPU is reacted with an isocyanate composition comprising iia) aliphatic isocyanates having at least three isocyanate groups and iib) aromatic isocyanates having two isocyanate groups in a ratio of 1:1 to 1:10. As there is no suggestion of aliphatic isocyanates having at least three isocyanate groups and aromatic diisocyanates in the same composition a ratio of 1:1 to 1:10, the claimed invention is clearly not rendered obvious by the cited reference.

Page 3 of the official action asserts that the mere disclosure of both aliphatic at least triisocyanates and aromatic diisocyanates would allow one of ordinary skill in the art to immediately envision a relative ratio of 1:1.

Such reasoning is completely unfounded. The examiner is respectfully invited to provide explicit documentation for such an analysis as the clarity of such a ratio is not forthcoming from the disclosure. When offered a gin and tonic, does the examiner immediately envision a ratio of 1:1? Simply because two components are present does not immediately suggest a 1:1 ratio.

In the area of chemistry, when the examiner is apprised of a catalyzed reaction, does he immediately envision a reaction ratio of 1:1? There is simply no basis to apply a binary analysis to a ratio which is completely variable through the possible mixing ratios of a two component combination.

Moreover, the examiner's analysis is over simplified as the reference does not simply disclose a binary world of aliphatic at least triisocyanates and aromatic diisocyanates. Clearly, aromatic at least triisocyanates are described and the reference says scant little as to the nature of the blocked diisocyanate such that a 1:1 ratio of aliphatic at least three isocyanate groups and aromatic diisocyanates would not be immediately envisioned.

As a further technical note, the relative ratio of aliphatic at least triisocyanate to aromatic diisocyanate is not particularly dictated by the reaction stoichiometry since the aliphatic at least triisocyanate and aromatic diisocyanate are **both isocyanate components** and therefore compete with reaction with isocyanate reactive groups (e.g. alcohols and amines). For this reason, there is no reason to base the content of aliphatic at least triisocyanate on the content of aromatic diisocyanate for the purposes of reaction with isocyanate reactive groups.

To the contrary, faced with the free ability to react triisocyanates and diisocyanates, Lagneaux et al **prefers** reaction of **only triisocyanate**. (paragraph [0021]). A ratio of 1:1 to 1:10 is not suggested nor the enhanced processing and properties realized from the claimed ratio.

Since the cited reference fails to suggest the claimed ratio of 1:1 to 1:10 nor the enhanced processing and properties realized thereby, the claimed invention is not rendered obvious by the cited reference and accordingly, withdrawal of the rejection under 35 U.S.C. 103(a) is respectfully requested.

The remaining rejections of claim 3 under 35 U.S.C. §103(a) in further view of Sapper U.S. 2003/0032179, of claims 5 and 6 under 35 U.S.C. §103(a) in further view of Porter et al., of claim 10 under 35 U.S.C. §103(a) over Lagneaux et al. (PCT FR02/03646) and of claim 11 under 35 U.S.C. §103(a) in further view of Enlow et al. U.S. 6,254,712 are believed to be moot as none of these rejections apply to claims 7 and 8, which are currently being pursued. Applicants reserve the right to pursue the subject matter of original claim 1 is a continuation application.

Applicants submit that this application is now in condition for allowance and early notification of such action is earnestly solicited.

Respectfully submitted,

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